

## Particularities of the Correlation Between the Unemployment Rate and the GDP in the Dynamics of the Romanian Economy

---

By

Dorel Savulea<sup>1</sup>

### Abstract:

*This paper tries to outline some aspects of the interdependency between the unemployment rate and the GDP rhythm under the specific circumstances of the Romanian economy in the pre-accession period to the EU. The paper presents two methodological versions used in the study of this correlation, namely: the version of the level of the gross domestic product (LGDP) and the version of the growth rate (GR). The implementation of this methodology shows that the reversed connection between the two macroeconomic variables cannot be applied for Romania in the analyzed period. These situations are also proved and the end of the paper presents the way of using the results obtained for the preparation of predictions.*

**Keywords:** unemployment rate, gross domestic product, Okun law

**JEL Classification:** A13, E24, O11

### 1. Introduction

Romania's integration in the European structures presupposes some political, economic and social reforms which in order to be viable they need a new informational system, which, with the help of the objectivity, coherence and flexibility should allow at the same time the connection at the European level.

As a rule, the economic programs have as their purpose the accomplishments of the main objectives of the macroeconomic policy, namely: the economic growth, the employment, the stability of the prices and the improvement of the balance of external payments.

These objectives are quantified through four fundamental variables, through which the performances of each economy are measured, correlated and analyzed: the GDP rhythm of growth, the unemployment rate, the inflation rate and the balance of payment for the current account.

---

<sup>1</sup> PhD, Lecturer, Faculty of Mathematics and Computer Science, University of Craiova, A.I. Cuza Street, no. 13, postal code 200585, Craiova, Dolj, Romania, Tel. +40 251 413728, Fax: +40 251 412673,

E-mail: savulea@central.ucv.ro

\* The author would like to thank the anonymous reviewers for their useful comments

The macroeconomic results are registered and measured by specialized institutions, their knowledge and the analysis of their evolution having a special practical significance for the adoption of the decision of macroeconomic policy.

The unemployment is defined in the macroeconomic literature, as being a negative state of the economy, which is materialized in a structural and functional imbalance of the labour market, where the labour force supply is higher than the labour force demand from the part of the economic operators.

The emergence and the accentuation of the unemployment are caused by a high number of objective causes, among which one can mention: the reorganization of the economic activity, the insufficiency of the economic growth, the cyclic character of the economic evolution and the demographic explosion.

The rhythm of economic growth, under the circumstances of a high labour productivity, is not capable any more to create new working places, so that it could provide a full employment. On the labour market the disparity between the labour demand and the labour supply is against the latter.

At the same time, the economic crisis, characterised by drawbacks and stagnations of the economic activity, increases the number of the unemployed and their integration in the boom period can have a low level.

On an economic level, the unemployment registers a series of negative consequences both at a national and at an individual level. So, the exclusion of some part of the labour force influences the dynamic of the size of the Gross Domestic Product (GDP), meaning that the training, the qualification of the unemployed also presupposed expenses from both of the individual and the society, which shall not be recovered in the case of the long-term unemployment. This labour force, which is not part of the active employment, will not contribute to the GDP growth.

Taking into account the importance of the two variables in the economic dynamics of a country we consider that the study of the interdependencies is very appropriate for this case, under the specific circumstances of the accession process of Romania to the European Union.

In the 60's Arthur Okun tried to determine if there is any interdependence relation between the unemployment phenomenon and the GDP. The answer to this dilemma is known in economy under the name of Okun's law (Hall, 1991).

Due to the fact that the employees take part in the manufacture of the goods and services (of the output) and the unemployed do not produce economic goods, one can presuppose that the high level of the unemployment has to be accompanied by the reduction of the real GDP volume.

Okun's law – the relation between the modification of the unemployment and the output - is an important macroeconomic concept, both from a theoretical and an empirical point of view. Theoretically speaking, Okun's law represents the connection between the curve of the aggregate supply and the Phillips's curve. Empirically speaking, Okun's ratio is a leading line used in prediction and in the creation of the economic policies.

One will use in this paper the MINITAB 14.1 program of analysis and statistical processing for the implementation of the statistic-mathematical methods.

## **2. Methodological Aspects Regarding the Correlation between the Unemployment Rate and GDP**

In the reference literature one used for the study of this interdependence two versions, namely: the version of the level of the gross domestic product (LGDP) and the version of the growth rate (GR).

The basic idea underlined by LGDP is that when the output is under the level of the total employment, the unemployment rate will exceed the natural rate. Its equation is:

$$100 \cdot (O^p - O) / O^p = 2 \cdot (r - r^n) \quad (1)$$

where  $O^p$  – potential output,  $O$  – real observed output,  $r$  – unemployment rate measured in percentage points,  $r^n$  – natural rate (considered by Okun to be 4%).

The signification of the equation (1) is that for each percentage point of the unemployment rate above the natural rate, the real GDP will be with 2 percentage points below the GDP level, which was obtained for the full employment. This version is useful for the illustration of the material costs of the unemployment.

So, the costs of the unemployment, direct or indirect, point out the fact that this phenomenon is a waste of human and financial resources generated by the incomplete use of the production funds with implications on the social costs.

The direct costs are pointed out under the form of the financial deposits to the fund for the social protection of the unemployed which is mainly used for the payment of the unemployment aid, support allocation and the training and re-training of the unemployed.

The indirect costs are generated by the global diminution of the production and of the incomes from which the entire population could benefit. They are to be seen under the form of production losses determined by the lack of use of some capacities and technical means, which implies the reduction of the formation resources of the budgetary incomes, the deterioration of the qualification and the ability to work, the discouragement of the personnel on a professional, social and human level.

The version of the growth rate (GR) underlines the fact that when the output grown in a more slowly way than the full employment output, the unemployment will grow because the use of the production factors decreases.

For each 2 percentage points with which the growth rate of the GDP exceeds the growth rate of the GDP in the case of the full employment, during a year, the unemployment rate will decrease with one percentage point (Anghelache, 2003):

$$GR = 3 - 2\Delta r \quad (2)$$

where  $GR$  – growth rate of the GDP,  $\Delta r$  – modification of the unemployment rate.

The version of Okun's law is used in predictions.

Regarding the material costs of the unemployment, these are connected to the Okun ratio from the LGDP. Okun has initially estimated this ratio as being 3, but the statistical data proved that it has a value which is closer to 2 (almost 2,25). In both cases, the value of this coefficient is higher than 1 because of the following reasons:

- The discouraged unemployed: as the unemployment is growing, some unemployed stop searching working places, so one can say that they leave the labour force; and as a result the growth with 1 percentage point of the unemployment leads to the decrease with more than 1 percentage point in employment;

- "the unemployment " of the fixed capitals: when the individuals loose their jobs, the equipments will not be used so intense, so the productivity decreases;

- The hidden unemployment: the unemployment rate decreases, some workers will have a lower intensity of the labour.

Okun's procedure to predict the growth rate of the output, having a certain rate of the unemployment was wrong. Supposing that while the relation between the output and the unemployment is stable, Okun's procedure evaluates the output in the conditions of the full employment (which is said to take place at an unemployment rate of 4% (Dornbush, 2004). In reality, the best linear predictor of the output, namely the unemployment, is determined by the regression of the output towards the unemployment. There are situations when the regression of the unemployment is suitable for the output.

For the determination of the level of the expected unemployment, considering a certain value of the GDP, in the hypothesis of maintaining the economic circumstances for the studies period, the regression equation is relevant (3).

$$f(r) = \alpha + \beta \cdot f(GDP) \quad (3)$$

This method of the best linear approximation is called BLP ("best linear approximation").

### 3. The Determination of the Correlation between the Unemployment Rate and the GDP

We will try to determine Okun's law for Romania in the pre-accession period to the EU (2000-2006) considering the fact that in this period there were registered positive rhythms of economic growth.

This is a type 4 equation and, using the notations in (Capanu, 1997), the starting point is a relation type:

$$RGDP_{t/t-1} = \alpha \cdot (RS_t - RS_{t-1}) + b \quad (4)$$

or

$$RGDP_{t/t-1} = \alpha \cdot \Delta RS + b \quad (5)$$

In the linear regression equation (4), the variables are:  $RGDP$  which represents the rhythm of growth of the GDP and  $\Delta RS$  the modification of the unemployment from the year  $t$  to the year  $t-1$ , where  $RGDP$  is the variable dependent on the modification of the unemployment.

Table 1 contains the corresponding values of the regression variables and the graphic representation regarding the modification of the unemployment rate provided by ILO (International Labour Organization) as compared to the GDP level is shown in figure 1.

The application of the options *Stat\Regression* and *Stat\Basic Statistics\Correlation* of the statistical analysis program MINITAB 14.1 (Keller, 2002) allows the acquirement of some information as the coefficients of the regression equation, of the correlation coefficient and of the determination coefficient.

#### Regression Analysis: RGDP versus ΔRS

The regression equation is:  $RGDP = 6,04 + 0,536 \cdot \Delta RS$

Predictor	Coef	SE Coef	T	P
Constant	6,0411	0,7131	8,47	0,001
ΔRS	0,5362	0,6505	0,82	0,456

S = 1,74661 R-Sq = 14,5% R-Sq(adj) = 0,0%

#### Correlations: RGDP; ΔRS

Pearson correlation = 0,381

The analysis of the above-mentioned results points out the fact that the unemployment rate influences the level of the GDP with 14,5%.

At the same time, the value of the correlation coefficient (0,381) points out a direct correlation of weak intensity. The signification of this result is also noticed with the help of the Student(t) test (Vasilescu, 2003), where  $t$  calculated has the value 0,824. The tabular value of  $t$  for 4 degrees of freedom and  $\alpha/2=0,025$  is 2,776, respectively -2,776.

As the calculated value of  $t$  is in the interior of the interval of the tabular values, it means that the value of the coefficient is not significant so that there is a connection between the two variables.

It results that Okun's law identified for the period 2000-2006 is:

$$RGDP_{t/t-1} = 6,04 + 0,536 \cdot (RS_t - RS_{t-1}) \quad (6)$$

Significance: if the unemployment rate remains unchanged than the GDP will grow with 6,04% and for each percentage point of growth of the unemployment rate the rhythm of the real GDP will grow with 0,536 percentage points as compared to 6,04%.

In order to determine a reverse relation, Okun type between the modification of the unemployment rate and the modification of the GDP rhythm

of growth, we have to take into account the fact that the connection is different in phase (with a time gap).

The method used in BLP („best linear approximation”), and not the inversion of the equation corresponding to the Okun’s law; when using this method the starting point is the equation (3) where  $f(r)=RS_{t+1}-RS_t$ , and  $f(GDP)=RGDP_{t/t-1}$ .

Equation (3) is a linear regression equation, with the variables  $RGDP$  and  $\Delta RS$  where  $\Delta RS$  is the variable dependent on the GDP rhythm of growth. In table 2 the corresponding values of the regression variables are presented.

Using the options *Stat\Regression* and *Stat\Basic Statistics\Correlation* from the MINITAB 14.1, allows the achievement of the following information:

#### Regression Analysis: $\Delta RS$ versus $RGDP$

The regression equation is:  $\Delta RS = -0,02 + 0,007 \cdot RGDP$

Predictor	Coef	SE Coef	T	P
Constant	-0,020	1,566	-0,01	0,990
RGDP	0,0072	0,286	0,03	0,981
S = 1,34231 R-Sq = 0,00015% R-Sq(adj) = 0,0%				

#### Correlations: $\Delta RS$ ; $RGDP$

Pearson correlation = 0,013

The above-mentioned results point out a determination coefficient (R-Sq) of only 0,00015%, that is an almost null influence of the GDP rhythm on the unemployment rate.

The value of the correlation coefficient (0,013) shows a direct correlation of intensity which is extremely low. And in this case, the significance of this coefficient is observed with the help of the test Student (t) where  $t$  calculated has the value 0,026.

The tabular value of  $t$  for 4 degrees of liberty is  $\alpha/2=0.025$  is 2,776 respectively -2,776, so  $t$  calculated is inside the interval of the tabular values, which means that the value of the coefficient is not significant and that between the two variables there is no causal relation.

The relation between the unemployment rate as a resulted value and the GDP rhythm of growth is:

$$\Delta RS_{t+1/t} = 0,0074 \cdot RGDP_{t/t-1} - 0,02 \quad (7)$$

or

$$RS_{t+1} = RS_t + 0,007 \cdot (RGDP_{t/t-1} - 2,857) \quad (8)$$

So, the growth of the GDP rhythm with one percentage point in the  $t$  year will lead to a stagnation (actually a growth of only 0,007%) of the inflation rate in the year  $t+1$ .

It is noticed that the GDP evolution and the evolution of the unemployment rate in Romania in the period 2000-2006 does not respect the principle of the reverse correlation settled through the Okun's law.

At the same time, the GDP modification only partly explains the evolution of the unemployment rate, the correlation coefficient have a very low value.

A strong influence on the unemployment rate was exerted by the average rate of the bank interests (RMD), and in table 3 the rhythms of growth for the two macroeconomic variables are presented.

With the help of the following information are obtained:

#### **Regression Analysis: RS versus RMD**

The regression equation is:  $RS = 4,17 + 0,15 RMD$

Predictor	Coef	SE Coef	T	P
-----------	------	---------	---	---

Constant	4,1729	0,7737	5,39	0,003
----------	--------	--------	------	-------

RMD	0,15785	0,03324	4,75	0,005
-----	---------	---------	------	-------

S = 0,868782 R-Sq = 81,9% R-Sq(adj) = 78,2%

#### **Correlations: RS ; RMD**

Pearson correlation = 0,905

The above-mentioned regression equation, shows that for each growth (decrease) of the rate of interest in the  $t$  year, with 10 percentage points, the unemployment rate will grow(decrease) with 1,5 percentage points in the  $t+1$  year.

The analysis of the above-mentioned information points out a determination coefficient (R-Sq) of 81,9% that is a very strong influence of the rates of the bank interests on the unemployment rate. The value of the correlation coefficient (0,905) shows a direct correlation of high intensity.

An in this case, the signification of this coefficient is noticed with the help of the Student ( $t$ ) test, where  $t=4,75$ . The tabular value of  $t$  for 5 degrees of freedom is  $\alpha/2=0,025$  is of 2,571 respectively -2,571.

One notices that  $t$  calculated is outside the interval of tabular values, so the correlation coefficient is significant, and between the two variables there is a causal relation.

So, as we mentioned above, these calculi allow for some predictions to be made. In order to answer at the question: Which is the predicted value for the unemployment rate for 2008?, one can use a decision table where the entrances are the unemployment rate and the GDP rhythm of growth (table 4) and the outputs are the predicted values of the unemployment rate, calculated with the relation (8).

According to the data from the decision table one can carry out different scenarios:

- If in 2007, the real GDP growth rate is between 4% and 5,5% and the unemployment rate will be between 7,008% and 7,0019%;
- If GDP growth rate has values between 6% and 7%, and the unemployment rate has values between 7,2% and 8%, then the unemployment

rate will be situated in the minimum interval of 7,2022%-8,0022% and the maximum interval of 7,2029%-8,0029%;

- If the real GDP growth rate will be of 7,5%, and the unemployment rate of 7% then there will be a reduction of the unemployment rate of 7,0033.

#### **4. Conclusions**

This paper attempted to outline just a few aspects of the relation between the modification of the unemployment rate and the economic growth of Romania in the pre-accession period to the EU.

This type of correlation represents an important macroeconomic concept, both from a theoretical point of view but also from an empirical point of view and has been studied according to the Okun's law, elaborated in the 60's by the economics Arthur Okun.

This law proved to have a statistical character, and is not applicable for any country, but only for USA and only for the period when the analysis was made.

In the beginning there were presented some theoretical aspects regarding this interdependence, and namely: the version of the level of the gross domestic product (LGDP) and the one of the growth rate (GR).

The implementation of these methods under the circumstances of the Romanian economy from the period 2000-2006 pointed out that the law is only valid to a small extent. This situation is argued through the fact that the growth rate of the GDP only partly explains the evolution of the unemployment rate; the correlation coefficient has a quite small value.

That is why the conclusion is that other factors have acted upon the unemployment rate. Therefore, this paper points out that the average rate of the bank interests exerted a strong influence on the unemployment rate, the value of the correlation coefficient (0,905) showing a direct correlation of high intensity.

In the end, it was presented the way of using the results obtained in the elaboration of predictions regarding the unemployment rate according to the previous values registered by the GDP rhythm and the unemployment rate.



## References

1. Anghelache, C. and Capanu, I., 2003, "Macroeconomic Indicators. Economic calculation and analysis" (Economica Publishing House, Bucharest).
2. Capanu, I. and Wagner, P., 1997, "Macroeconomic Statistics", (Economica Publishing House, Bucharest).
3. Dornbush, R. and Fisher, S., 2004, "Macroeconomics", (McGraw-Hill, New York).
4. Hall, R., 1991, "Booms and Recessions in a Noisy Economy (Arthur Okun Memorial Lectures Series)", (Yale University Press Publishing House, New Haven, USA)
5. Keller, G. and Warrack, B., 2002, "Statistics for Management and Economics" (6 Edition, Duxbury Press, Belmont).
6. Vasilescu, N. and Costescu, M., 2003, "Statistics", (Universitaria Publishing House, Craiova).

## APPENDIX

**Table 1:** The GDP rhythm and the modification of the unemployment rate (2000-2006)

Regression variables	Years						
	2000	2001	2002	2003	2004	2005	2006
RGDP (%)	2,1	5,7	5,1	5,2	8,5	4,1	7,7
$\Delta$ RS (%)		-0,6	1,8	-1,4	1	-0,8	0,1

Source: NIS, Romanian Statistics Yearbook, 2006

**Table 2:** The GDP rhythm and the modification of the unemployment rate (2001-2006)

Regression variables	Years					
	2001	2002	2003	2004	2005	2006
$\Delta$ RS (%)	-0,6	1,8	-1,4	1	-0,8	0,1
RGDP*(%)	2,1	5,7	5,1	5,2	8,5	4,1

Source: NIS, Romanian Statistics Yearbook, 2006

\* RGDP value from the previous year

**Table 3:** The average rate of the bank interests and the rhythm of the unemployment

Regression variables	Years						
	2000	2001	2002	2003	2004	2005	2006
RMD (%)	35	35	20,40	18,85	20,16	9,68	8,45
RS (%)	10,50	8,80	8,40	7,40	6,30	5,90	5,20

Source: NIS (TEMPO database).

**Table 4:** Decision table with the rate of the bank interests and the unemployment rate

Calculus Relation*		Rhythm of Growth of the GDP in 2007						
		4,5	5	5,5	6	6,5	7	7,5
Unemployment rate in 2007	7,0	7,0012	7,0015	7,0019	7,0022	7,0026	7,0029	7,0033
	7,2	7,2012	7,2015	7,2019	7,2022	7,2026	7,2029	7,2033
	7,4	7,4012	7,4015	7,4019	7,4022	7,4026	7,4029	7,4033
	7,6	7,6012	7,6015	7,6019	7,6022	7,6026	7,6029	7,6033
	7,8	7,8012	7,8015	7,8019	7,8022	7,8026	7,8029	7,8033
	8	8,0012	8,0015	8,0019	8,0022	8,0026	8,0029	8,0033
	8,2	8,2012	8,2015	8,2019	8,2022	8,2026	8,2029	8,2033
	8,4	8,4012	8,4015	8,4019	8,4022	8,4026	8,4029	8,4033
	8,6	8,6012	8,6015	8,6019	8,6022	8,6026	8,6029	8,6033
	8,8	8,8012	8,8015	8,8019	8,8022	8,8026	8,8029	8,8033
	9,0	9,0012	9,0015	9,0019	9,0022	9,0026	9,0029	9,0033

$$*RS_{2008}=RS_{2007}+0,007\cdot(RGDP_{2007}-2,857)$$

**Figure 1:** The modification of the unemployment rate as compared to the GDP rhythm